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Measuring system / optical gage

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SHELSTON WATERS

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SYDNEY NSW 2000

23 September 1992

Filing Receipt for COMPLETE Application

Reference : 16644
Applicants: Henry Graf

Title : Measuring device

The following documents were lodged at the Patent Office on 18th of September 1992 and allocated application number 25222/92.

Documents:
A complete specification, comprising 9 claims and 19 pages/drawings, and including a patent request, a notice of entitlement, a true copy and an abstract.

Fees Paid: $237.00 (being the CORRECT fees)

Please note that lodgement of this application does not entitle the applicant to claim that a patent has been granted.

The application no. 25222/92 should be used in any further correspondence with the office.

Commissioner of Patents

CABINET MONNIER

fondé en 1932

BREVETS D'INVENTION MARQUES DE FABRIQUE MODELES

142-150, Cours Lafayette - F-69003 LYON

B.P. 3058 69393 LYON CEDEX 03

G. MONNIER
Licencié en Droit

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Conseils en Propriété Industrielle
Mandataires près l'Office Européen des Brevets
European Patent Attorneys

E. GARIN
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Jh. MONNIER
1932-1992

Docteur Henry GRAF
8, rue Duquesne
69006 LYON

N/Réf. rk/bf 10123 le 4 novembre 1992

Nouvelle Demande de brevet en AUSTRALIE
"Dispositif de mesures d'amplitudes"

Cher Docteur,

Conformément à vos instructions, nous vous informor que la demande de brevet ci-dessus correspondant à l demande de brevet français 91 11964 du 24 septembr 1991 a été déposée en date du 18 septembre 1992.

Nous vous adressons ci-joint le texte tel que dépos auprès de l'Office australien des Brevets, ainsi que l certificat de dépôt correspondant. Vous noterez qu votre demande porte le N° 25222.92.

Dans l'attente de l'examen de cette demande, nous vou adressons ci-joint notre note d'honoraires pour notr intervention et celle de notre confrère.

Vous souhaitant bonne réception de la présente,

Nous vous prions d'agréer, cher Docteur, l'expression de nos sentiments les meilleurs.

Roger KARMIN

P.J.: Documents justificatifs de dépôt - Certificat de dépôt - Note de débit

Cabinet MONNIER
BREVETS D'INVENTION

142-150, Cours Lafayette
F - 69003 LYON
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Télex 330 470 F MONIPAT

B.P. 3058 69393 LYON Cedex 03

Docteur Henry GRAF
8, rue Duquesne
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Le 4 novembre 19 92 **NOTE DE DÉBIT N°** 10123

Nouvelle demande de brevet en AUSTRALIE N° 25222/92 du 18 septembre 1992

- Préparation et dépôt d'une nouvelle demande de brevet en AUSTRALIE :
- Préparation d'une traduction jurée de la copie officielle de la demande prioritaire FR 91 11964 ;
- Paiement des taxes de dépôt ;
- Constitution de mandataire ;

FRAIS ET HONORAIRES	FF 15 000,-
T.V.A 18,6 %	FF 2 790,-
MONTANT TOTAL T.T.C.	FF 17 790,-

EN VOTRE AIMABLE REGLEMENT

T.V.A. acquittée sur les encaissements

Ce montant doit être déclaré en fin d'exercice sur l'état DAS 2

PTO-103X
(Rev. 11-86)

FILING RECEIPT

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SERIAL NUMBER	FILING DATE	GRP ART UNIT	FIL FEE REC'D	ATTORNEY DOCKET NO.	DRWGS	TOT CL	IND CL
07/950,632	09/14/92	3309	$ 345.00	11725	6	8	1

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Receipt is acknowledged of the patent application identified herein. It will be considered in its order and you will be notified as to the examination thereof. Be sure to give the U.S. SERIAL NUMBER, DATE OF FILING, NAME OF APPLICANT, and TITLE OF INVENTION when inquiring about this application. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this transmittal.

Applicant(s) HENRY GRAF, LYON, FRANCE.

FOREIGN/PCT APPLICATIONS-FRANCE 91 11964 09/24/91

* SMALL ENTITY *

TITLE
MEASURING DEVICE

PRELIMINARY CLASS: 128

(see reverse)

CABINET MONNIER

Fondé en 1932

BREVETS D'INVENTION · MARQUES DE FABRIQUE · MODELES

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1932-1992.

Docteur Henry GRAF
8, rue Duquesne
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N/Réf. rk/bf 10121 — 4 novembre 1992

Votre demande de brevet aux USA pour DISPOSITIF DE MESURE d'AMPLITUDES

Cher Docteur,

A la suite de notre courrier du 26 octobre dernier nous vous adressons ci-joint le certificat de dépôt de la demande en rubrique. Vous noterez que votre demande porte le N° 07/950,632.

Nous ne manquerons pas de vous tenir informé des suites de cette affaire, et dans cette attente,

Nous vous prions d'agréer, cher Docteur, l'expression de nos sentiments distingués.

Roger ARMIN
P.J.

Cabinet MONNIER
Brevets d'Invention - Marques - Modèles – 142-150, cours Lafayette F. 69003 LYON

DEMANDE DE BREVET D'INVENTION

PAYS :	AUSTRALIE
TITRE :	MEASURING DEVICE
NOM :	Docteur Henry GRAF
N° :	25222/92
DATE :	18 septembre 1992
DURÉE :	
PRIORITÉ (S) :	Demande de brevet en FRANCE N° 91 16964 du 24 septembre 1991
INVENTEUR(S) :	Docteur Henry GRAF

AUSTRALIA

PATENTS ACT 1990

COMPLETE SPECIFICATION

FOR A STANDARD PATENT

ORIGINAL

Name of Applicant: HENRY GRAF

Actual Inventor: HENRY GRAF

Address for Service: SHELSTON WATERS
55 Clarence Street
SYDNEY NSW 2000

Invention Title: "MEASURING DEVICE"

The following statement is a full description of this invention, including the best method of performing it known to me/us:-

FIELD OF THE INVENTION

The present invention relates to a device intended to measure, on the one hand, the angle of freedom of two adjacent vertebrae in torsion and, on the other hand, the angle of freedom of these vertebrae in lateral inflexion with respect to a given position in flexion-extension of said vertebrae.

BACKGROUND OF THE INVENTION

In theory, it is considered that the intervertebral articulation comprises 6° of freedom, but, in practice, the principal freedom of the articulation lies in flexion-extension. Similarly, but to a lesser amplitude, there exist degrees of freedom upon intervertebral horizontal rotation or lateral flexion.

It should also be noted that these two movements are usually linked with each other, i.e. the lateral flexion necessarily causes a certain horizontal degree of rotation, and vice versa.

The problem of this lumbar intervertebral articulation is that it is rapidly subject to damage, leading to a reduction in the rubbery quality of the disc. Such deterioration results in a greater suppleness of the articulation, which brings about more ample movements both in flexion-extension, but also in lateral inflexion and in torsion.

The reduction in the rubbery quality of the disc leads to a complete disorganization of the movements of the lumbar intervertebral articulation.

It therefore seems important, for certain therapeutical decisions, both to be able to measure the amplitude of all the intervertebral movements and to have an idea of the disorganization of the coupling of the movements with respect to one another.

It is a particular object of the present invention to provide a solution to this problem.

SUMMARY OF THE INVENTION

The purpose of the present invention is to design a measuring device capable of indicating, at any moment and in any position, the three-dimensional rotations of one vertebra with respect to the other. This device makes it possible in particular to assess the movements of intervertebral inflexion and rotation at certain places of the intervertebral flexion-extension.

The measurements obtained by this device will make it possible to take decisions for certain therapeutical positions, and this "in vivo", during the operations. The measuring device may be used outside surgery, abutting percutaneously on the intervertebral spines. During an operation, the measuring device will abut on screws which will be placed in the pedicles of the vertebra.

The device according to the invention for measuring the amplitudes of two vertebrae comprises two reference elements rigidly associated respectively with each vertebra, means associated with two reference elements and measuring the angle of freedom of the vertebra considered in torsion, i.e. in a plane perpendicular to the longitudinal axis of these vertebrae, and other means associated with said elements for measuring the angle of freedom of the vertebrae in lateral inflexion, i.e. in a plane perpendicular to that of the spinous processes as a function of a given position in flexion-extension of said vertebrae, i.e. in the plane containing the spinous processes.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be more readily understood on reading the following description with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of the device according to the invention.

Figure 2 is a plan view of this device.

Figure 3 is a view similar to that of Figure 1, but illustrating two adjacent vertebrae displaced angularly with respect to each other in the sense of a cyphosis.

Figure 4 shows the measurement of the angle of twist of the two vertebrae from their position illustrated in Figure 3.

Figure 5 is a view similar to that of Figure 2, but illustrating the measurement of the angle of displacement of the two vertebrae in lateral inflexion from their position of Figure 3.

Figure 6 is a perspective view of a variant embodiment of the device of Figure 1.

DETAILED DESCRIPTION OF THE DRAWINGS

Referring now to the drawings, Figure 1 illustrates two adjacent vertebrae 1, 2 separated in conventional manner by a disc 3. X-Y designates the longitudinal axis of the vertebrae and a plane P containing this axis is shown, as well as the spinous processes 1a, 2a of the vertebrae 1 and 2. This Figure also shows a transverse plane Q passing through the disc 3 and orthogonal with respect to the axis X, Y as well as to plane P. A third plane R containing axis X, Y has also been shown in Figure 1, its orientation being orthogonal with respect to the two planes P and Q.

In the following specification, the term flexion-extension will designate the movement of the vertebrae in position, for example, of cyphosis in which the axis X-Y becomes curved whilst remaining in plane P. The term torsion will designate the rotation of one vertebra with respect to the other in planes parallel to plane Q. Finally, lateral inflexion will designate the movement of the vertebrae with respect to each other such that axis X-Y becomes curved whilst

remaining in plane R.

The device according to the invention firstly comprises two small columns 4, 5 of which one of the ends is respectively fixed to each of the vertebrae 1 and 2 by any appropriate means, for example implants or screws 6, 7. The two small columns rise slightly obliquely in order that the free end of column 4 is offset laterally with respect to plane P whose trace has been shown in Figure 2, whilst the free end of column 5 is virtually contained in this plane.

The free end of column 4 comprises an endpiece 4a of smaller diameter, which engages freely in the hole of a block 8 comprising a small bar 9 extending parallel to column 4. This bar comprises two pivots 9a, 9b.

The upper part of column 5 is fast with an oblique flat section 10 to which is fixed a rod 11 extending substantially parallel to axis P (cf. Figure 2). On this rod is mounted to slide freely a carriage 12 to which is fixed a segment of circle forming dial 13 which is suitably graduated and parallel to plane P. On its lateral face, the carriage 12 comprises a pivot 12a parallel to those 9a, 9b of bar 9. A supple connecting rod 14 is articulated on pivots 9b, 12a. About the latter pivots the apex of a square bracket 15 of which one, 15a, of the arms, parallel to bar 9 and of the same length, is provided with a pivot pin 16 for one of the ends of a supple connecting rod 17 of which the other end is articulated on pivot 9a. The other arm 15b of the square bracket 15 constitutes a needle which moves in front of the graduated portion of the dial 13. The two connecting rods 14, 17, the bar 9 and the arm 15a of the needle 15 form a deformable parallelogram.

The upper part of the column 4 located immediately below the block 8 is provided with an oblique flat

section 18 fast with a rod 19 extending perpendicularly to column 4 and virtually parallel to rod 11, as illustrated in Figure 2. A carriage 20 is mounted to slide freely along rod 19. This carriage bears a suitably graduated dial 21 disposed parallel to plane R as well as a pin 20a about which is articulated a needle 22 of which the end opposite that located in front of the graduation of dial 21 is articulated about the free end 5a of column 5.

A bearing 23, substantially parallel to plane R, is fixed to section 18, its orientation being perpendicular to the plane formed by this column 4 and rod 19. In this bearing is mounted for free rotation the end of one of the arms 24a of a square-bent rod 24 of which the second arm, parallel to rod 19, receives for free slide a block 25 bearing a graduated dial 26 oriented substantially parallel to plane R. This block is also fast with one of the ends of a bar 27 of which the other end comprises a head 27a traversed for free slide by a rod 28 fast with the second column 5. This rod presents the form of a square bracket of which the arm 28a which cooperates with the head 27a is perpendicular to the plane determined by the column 5 and the rod 11. The arm 28a of the rod 28 receives with free slide a block 29. The latter, the block 25 and the head 27a respectively bear pivots 29a, 25a and 27b. Between pivots 27b and 29a is mounted a lever 30. A lever 31 is articulated by one of its ends on pivot 29a and by its other end on a pin 32 fast with a needle 33 of which the end opposite its indicator part is articulated about pivot 25a. In this way, the bar 27, the levers 30 and 31 and the needle 33 form a deformable parallelogram.

Operation is as follows: during the measurement of the amplitude of the clearance of the two vertebrae

1 and 2 in the sense of flexion-extension, the curvature of the vertebrae in this sense creates an angle α (Figure 3) between columns 4 and 5, so that the end 5a of column 5 moves away from that, 4a, of column 4 (arrow F_1), said columns being displaced in planes parallel to plane P. Such displacement provokes slide of the carriage 12 along the rod 11, so that the deformable parallelogram formed by bar 9, the two supple rods 14, 17 and the arm 15a of the needle 15 is deformed, bringing about the displacement of the end of the needle 15 with respect to the graduation of the dial 13 to indicate the value of the angle α. Of course, this displacement also causes the carriage 20 to slide with respect to rod 19, but without noteworthy modification of the position of the needle 22. Simultaneously, the rod 28 tips in the direction of the vertebrae, which provokes a rotation of the rod 24 in the bearing 23. Due to the parallelism between rods 11 and 19, the position of the needle 33 with respect to the graduation of the dial 26 does not visibly vary.

From any relative position of flexion-extension of the two vertebrae 1 and 2, it is possible to measure the amplitudes in rotation and in lateral inflexion of the two vertebrae.

If the vertebrae are displaced in lateral inflexion, i.e. giving axis X-Y a curvature in plane R, the two columns 4 and 5 effect complex rotations, so that, on the one hand, carriage 20 slides along rod 19 due to the spaced apart relationship of the two columns 4 and 5 and, on the other hand, rod 28 changes relative position with respect to rod 24, moving away from it in the direction of arrow F2 (Figure 5), whilst tipping in the direction of arrow F3. Under these conditions, the deformable parallelogram 27,

30, 31, 33 is deformed and the end of the needle 33 moves with respect to the graduation of the dial 26 to indicate the maximum angle of clearance of the two vertebrae in lateral inflexion.

The maximum angle of rotation of one vertebra with respect to the other in plane Q may also be measured. The relative displacement of the two columns 4 and 5 in this plane Q, in the case of lateral flexion, causes the two ends 4a and 5a of said columns to move apart, which causes, on the one hand, slide of the carriage 20 on rod 19 and a subsequent rotation of the needle 22 whose end moves in front of the graduation of the dial 21 to indicate for example the maximum amplitude of freedom of the two vertebrae in the direction of the rotation.

Under these conditions, the utility of providing the supple connecting rods 14 and 17 so that they may follow without deformation the relative movements of the columns 4 and 5 in rotation and in lateral inflexion, will be understood.

Of course, proximity gauges or potentiometers may be provided at the level of pins 12a of carriage 12, 20a of carriage 20 and 25a of block 25 to measure the angles of clearance by means of an electronic converter with digital display or like apparatus to which the gauges or potentiometers would be connected.

Figure 6 illustrates a variant embodiment of the measuring device according to the invention.

The device illustrated in Figures 1 to 6 allows the measurement of the angles of torsion, of lateral inflexion and of flexion-extension of adjacent vertebrae but without reference to the force applied on these vertebrae to displace them in the three directions mentioned above.

On the contrary, in accordance with the device

of Figure 6, it is possible to measure the angles of torsion and of flexion-extension of the vertebrae 1 and 2 as a function of the force exerted thereon via the columns 4 and 5 which each comprise a strain gauge 34. This gauge is placed in the vicinity of the fixation of columns 4 and 5 with respect to the screws or implants 6, 7 connected to the vertebrae 1 and 2. Columns 4 and 5 are in fact constituted by rods bent twice as an S and which are disposed substantially in the plane P containing the longitudinal axis X-Y of the spine.

The ends 4a, 5a of the rods which are located substantially parallel to screws 6 and 7 bear at their ends a rotatable proximity gauge 35 adapted to rotate in a block 36. The opposite faces of the two blocks 36 each comprise a fork joint 36a in which is articulated one of the ends of a connecting rod 37, 38 respectively. The opposite end of the connecting rod 38 is fast with a proximity gauge 39 rotating with respect to a pin fixed to the corresponding end of the other connecting rod 37. In this way, rods 37 and 38 substantially form compasses of which the legs are displaced in plane P.

Gauges 34, 35 and 39 are connected to an electronic converter 40 with digital display adapted to display the angles of torsion and of flexion-extension of the vertebrae 1 and 2 as a function of the effort applied thereon by displacing rods 4 and 5 either in torsion or in flexion-extension.

This measurement is therefore effected for example in torsion by displacing the two rods 4 and 5 in two opposite directions perpendicularly to plane P. This displacement provokes rotation of the proximity gauges 35 with respect to the blocks 36, the blocks remaining in plane P due to their link with connecting rods

37 and 38.

If it is desired to measure the angle of flexion-extension, rods 4, 5 are displaced in plane P in opposite direction, which provokes displacement of the two blocks 36, moving away from each other so that, in that case, it is gauge 39 which measures the variation of the angle of the connecting rods.

It goes without saying that the proximity gauges may be replaced by rotatable potentiometers without departing from the scope of the invention or by any other like device.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A device for measuring the amplitudes of two vertebrae in three orthogonal planes, wherein it comprises two reference elements rigidly associated with each vertebra respectively, means associated with the two reference elements and measuring the angle of freedom of the vertebrae in question in torsion, i.e. in a plane perpendicular to the longitudinal axis of these vertebrae, and other means for measuring the angle of tip of the vertebrae in flexion-extension.

2. The device of Claim 1, wherein it further comprises means associated with said reference elements and measuring the angle of freedom of the vertebrae in lateral inflexion, i.e. in a plane perpendicular to that of the spinous processes as a function of a given position of flexion-extension of said vertebrae, i.e. in the plane containing the spinous processes.

3. The device of Claim 1, wherein the reference elements are two small columns whose lower ends are anchored in the vertebrae, the first column comprising a block mounted to rotate freely about the longitudinal pin of said column comprising a small bar parallel thereto and which is provided with two spaced apart pivots on which are articulated the ends of two supple connecting rods forming with one of the arms of a needle a deformable parallelogram of which one of the pivot pins is borne by a carriage mounted to slide freely with respect to a rod fixed perpendicularly to the second column, whilst the carriage bears a dial in front of which the free arm of the needle moves.

4. The device of Claim 1, wherein the reference element is a first column fast with a rod oriented perpendicularly to this column and on which rod is mounted for free slide a carriage bearing a dial and a pivot on which is articulated a rectilinear needle also articulated with respect to the free end of the second column which constitutes the second reference element.

5. The device of Claim 2, wherein a bearing is fixed to the reference element constituted by a first column, being oriented perpendicularly to the plane formed by this column and the rod which is fast therewith and in which is mounted for free rotation the end of one of the arms of a square bent rod of which the second arm, parallel to the rod, receives with free slide a block bearing a dial, said block being fast with one of the ends of a bar of which the other end comprises a head bearing a pivot and which is traversed with free slide by a rod fast with the second element taking the form of a column and oriented perpendicularly to the plane that this column determines with its fixed rod, said rod receiving for free slide a block provided with a pivot, whilst levers are articulated on the pivots of the head and of the block and on a needle articulated on the block to form with the bar a deformable parallelogram.

6. The device of Claim 1, wherein the means for measuring the angles of freedom in torsion and in lateral inflexion are constituted by rotatable proximity gauges connected to an electronic converter with digital display.

7. The device of Claim 2, wherein the means for measuring the angle of freedom of the vertebrae in lateral inflexion are constituted by rotatable proximity gauges connected to an electronic converter with digital display.

8. The device of Claim 1, wherein the two reference elements associated with the vertebrae are each provided with a strain gauge, the ends of said reference elements being associated with a rotatable proximity gauge rotating in a block on which is articulated a connecting rod, the two connecting rods disposed in the plane being associated with a pivot pin associated with a rotatable proximity gauge fast with one of the connecting rods, said strain and proximity gauges being connected to an electronic converter with digital display indicating the angles of torsion and of flexion-extension of the vertebrae as a function of the effort applied thereon.

9. A device for measuring the amplitudes of two vertebrae in three orthogonal planes substantially as herein described with reference to Figures 1 to 5 and Figure 6 of the accompanying drawings.

DATED this 18th day of SEPTEMBER, 1992
HENRY GRAF

Attorney: LEON K. ALLEN
Fellow Institute of Patent Attorneys of Australia
of SHELSTON WATERS

ABSTRACT OF THE DISCLOSURE

This invention relates to a device for measuring angles of freedom of adjacent vertebrae, comprising two reference elements (4, 5) rigidly associated with each vertebra respectively, means associated with the two reference elements (4, 5) and for measuring the angle of freedom of the vertebrae in question in torsion, i.e. in a plane (Q) perpendicular to the longitudinal axis of these vertebrae and other means associated with said elements (4, 5) for measuring the angle of freedom of the vertebrae in lateral inflexion, i.e. in a plane (R) perpendicular to that of the spinous processes as a function of a given position of flexion-extension of said vertebrae, i.e. in the plane containing the spinous processes.

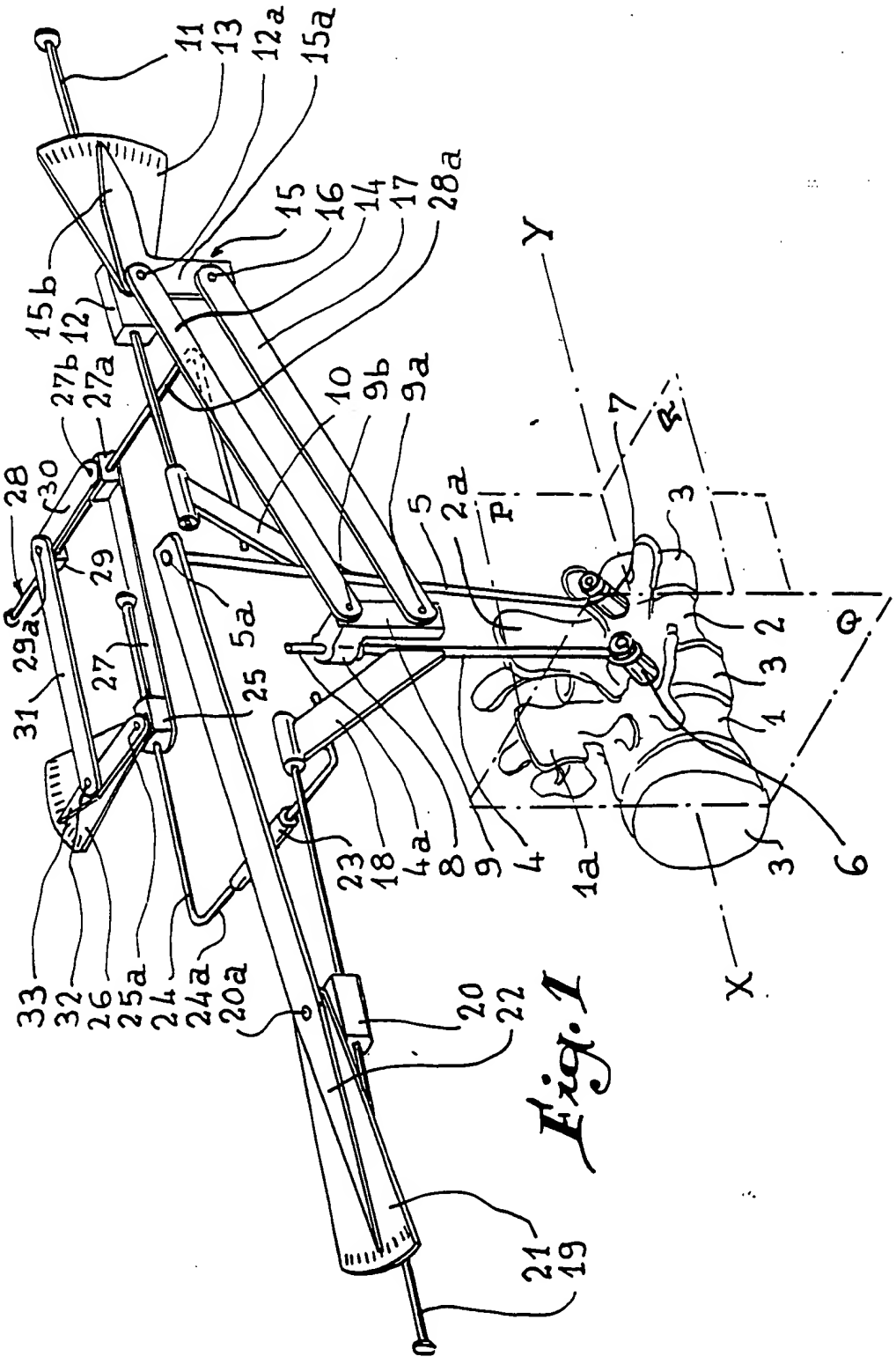
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Fig. 1

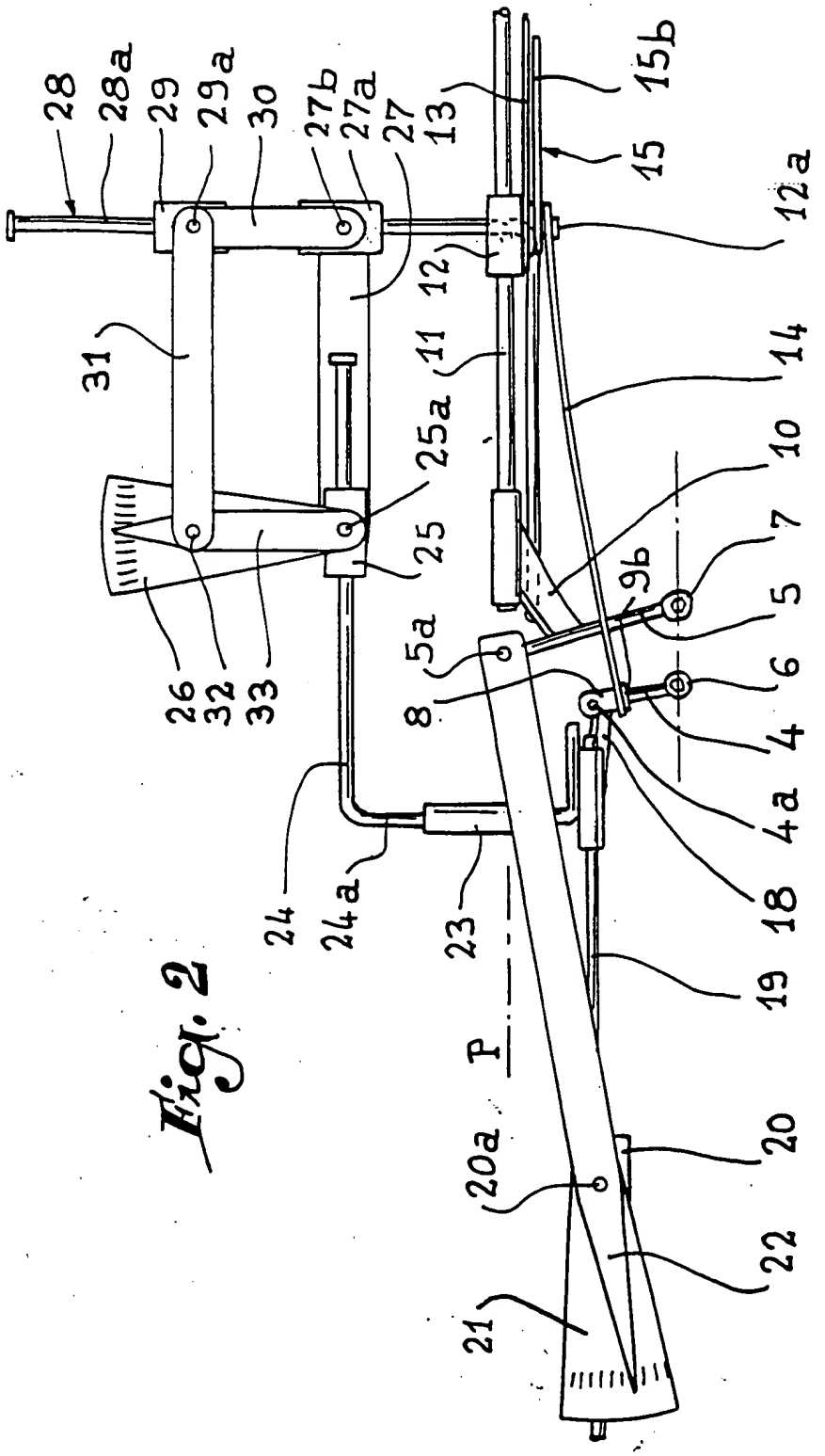
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Fig. 2

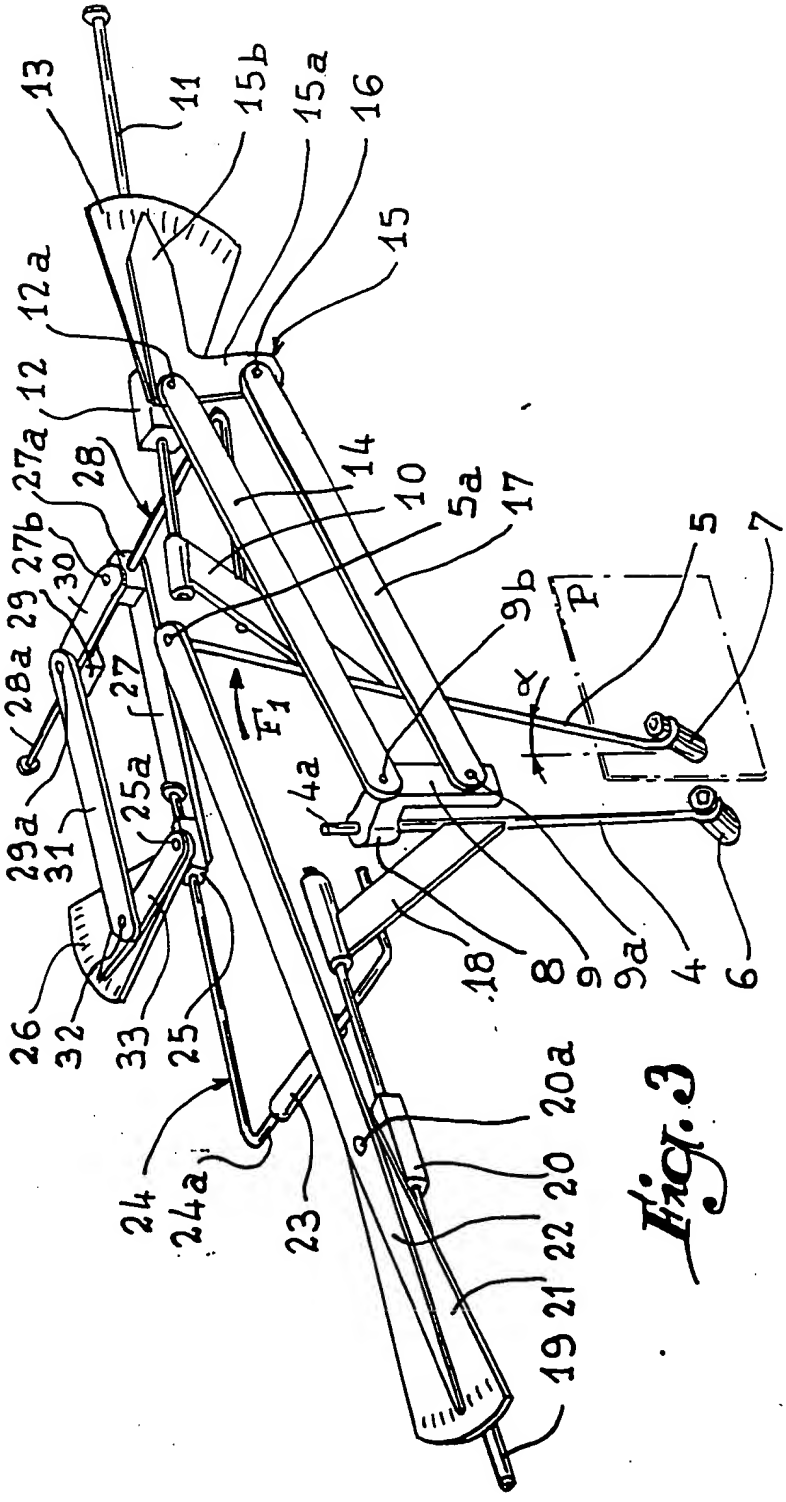
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Fig. 3

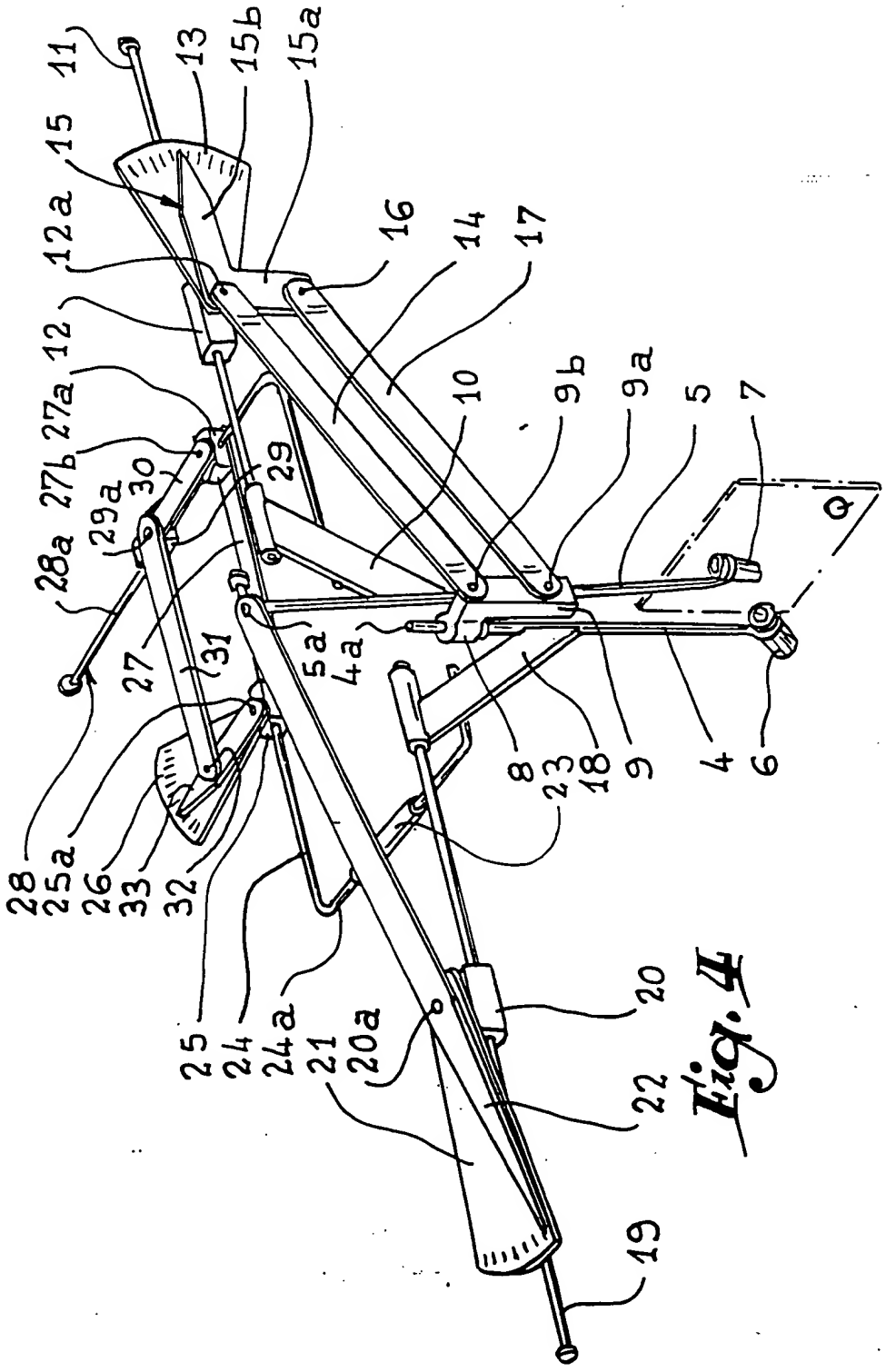
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Fig. 4

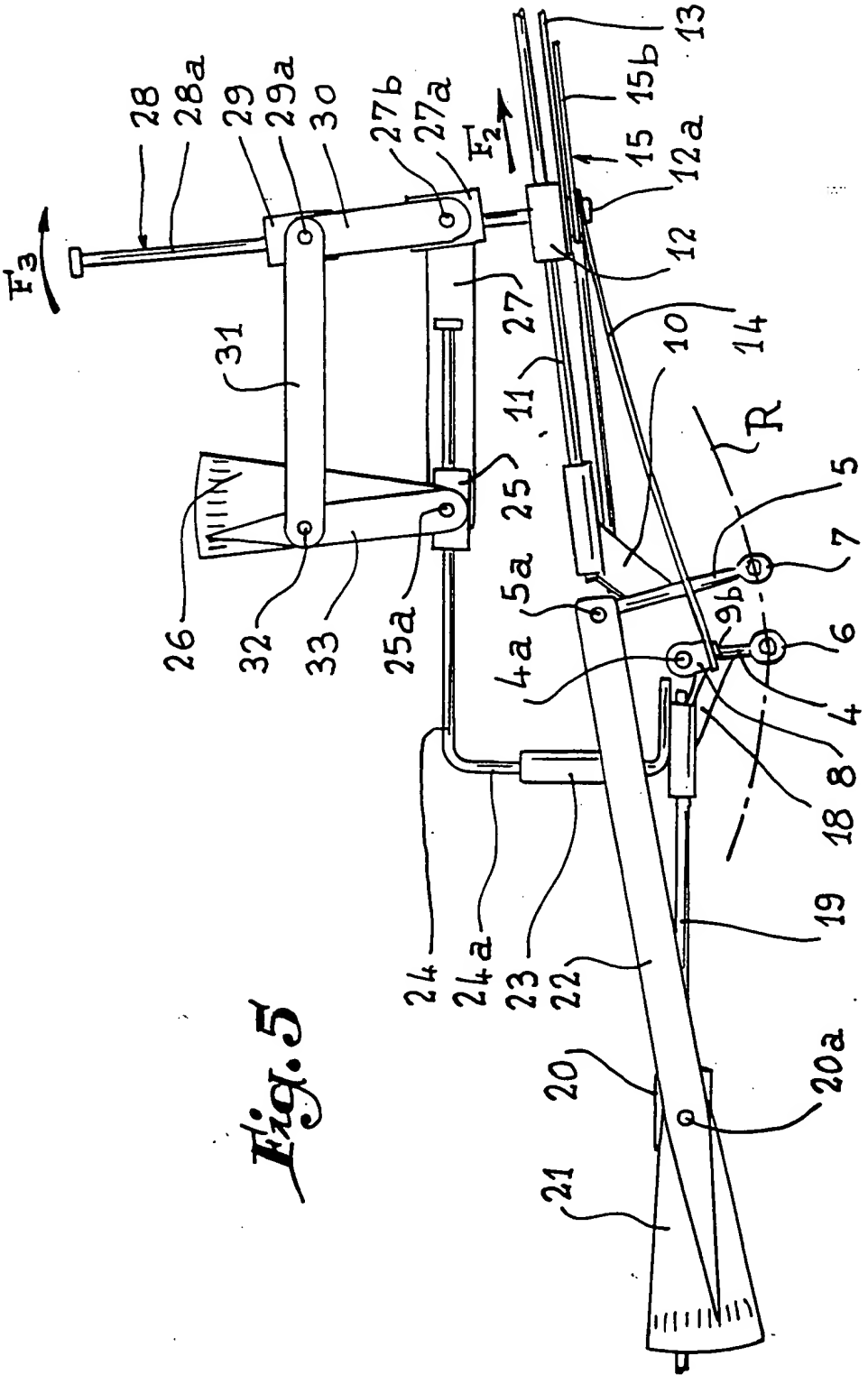
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Fig. 5

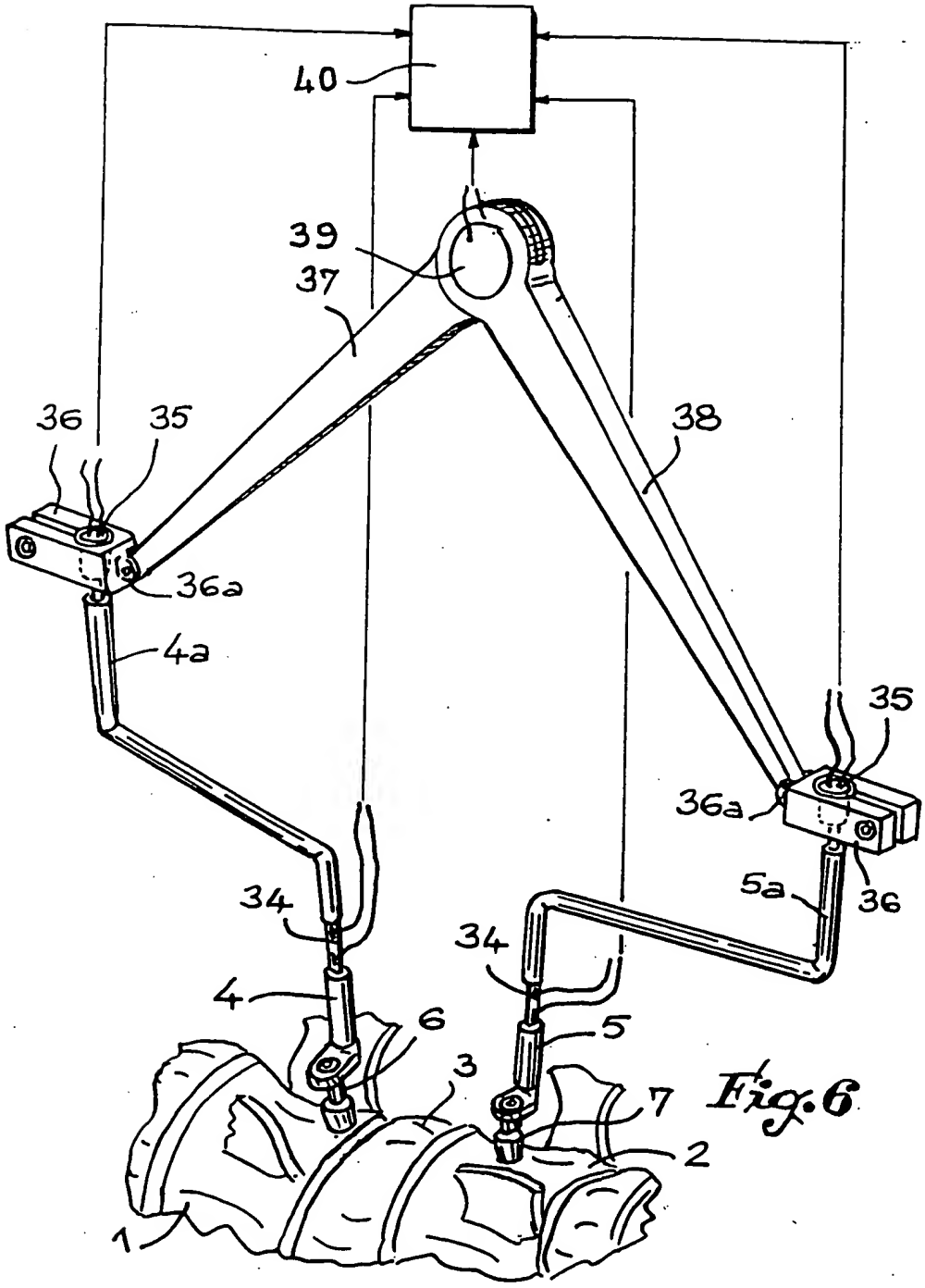

Fig.6

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